

EVALUATION OF THE USE OF TIM-BOR^R FOR THE CONTROL OF ANNOSUM ROOT DISEASE

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Borax (sodium tetraborate decahydrate) has been shown to be effective in preventing infection of pine stumps by Heterobasidion annosum Bref. in California (Graham, 1970). The principal area of concern and use in California is in the eastside pine type on the Klamath, Shasta-Trinity, Modoc, Lassen, Plumas, and Tahoe National Forests and intermingled lands of other ownerships. In 1990, over 17,000 pounds of granular borax were applied to freshly cut stump surfaces on National Forest System lands in California.

The topography in many of these areas lends itself to mechanical harvesting practices using various types of tractor-mounted shears and saws. Using borax in these sales requires additional labor to apply the material directly to each stump after a tree is felled. Developing a means to incorporate mechanical application of borate into the harvesting process could reduce harvesting costs. In addition, application at the time of felling will reduce the probability of stumps being missed and not treated.

Borax does not readily solubilize in water and will not work properly in a tractor-mounted spray system. Water-soluble borate salts are available, but have not been tested for efficacy against H. annosum in California. Tests have been performed in the southeastern U.S. and have shown that TIM-BOR^R (U.S. Borax) is effective in preventing stump infection in slash and loblolly pines (Blakeslee, personal communication).

The purpose of this study was to evaluate the efficacy of TIM-BOR^R in preventing infection of ponderosa and Jeffrey pine stumps by H. annosum in California.

METHODS

Timber sales with mechanical harvesting were examined in two areas: McCloud Ranger District, Shasta-Trinity National Forests, and Devils Garden Ranger District, Modoc National Forest. Commercial size ponderosa pines were harvested on the McCloud District with a Timbco Roto-saw on April 16, 1990 in a 5 acre clearcut. Submerchantable ponderosa pines on the Devils Garden District were felled with a Hydro-Ax 711 shearer on July 9, 1990 in a thinning operation.

Following harvest, four treatments with 20 stumps per treatment, were established in each area. Individual stumps were marked to identify the treatment. Stump diameters inner bark were measured to the nearest 0.1 foot in

2 directions and averaged. All treatments and inoculations were done within 24 hours of cutting.

The four treatments were: 1) control - uninoculated, 2) control^R - inoculated, 3) TIM-BOR^R - inoculated, and 4) TIM-BOR^R - uninoculated. TIM-BOR^R powder was added to water in a garden sprayer at the rate of 54 g/l (0.45 lb/gal), then agitated. This rate provides an equivalent amount of boron that is applied when granular borax is used at the EPA registered rate (1 pound per 50 square feet of stump surface). It was applied to stumps to the point of run-off. Inoculum was prepared from two isolates of H. annosum that were grown for about 1 month on potato dextrose agar. A slurry of mycelia and conidia was produced by adding distilled water to inoculum dishes and scraping the agar surface. The slurry was refrigerated until use within 24 hours of preparation. Inoculations involved application of the aqueous suspension with a garden sprayer to stump surfaces following tree harvest. Enough inoculum was sprayed on each stump to thoroughly wet the surface. A small amount was sprayed on PDA plates to check viability of the fungus at each location.

Six to nine weeks following treatment, stumps were evaluated for infection by H. annosum. The surface 1 inch of the stump was removed and a 1 inch thick disk was cut to incubate for the presence of the fungus. The new stump surfaces were treated with borax. Each disk was wrapped in moistened newspaper and stored in a plastic bag. Disks were examined for Spiniger meineckellus (Olson) Stalpers, the asexual stage of H. annosum, following 7-10 days of incubation.

RESULTS

Trees were cut on April 16 on McCloud District when the weather was sunny with air temperatures in the 60's ° F. During the night, there was some rain which continued into the day on April 17 when the treatments were applied. It was overcast and cool (50's ° F) with some misting during the time of treatment. Stump height was flush with the ground to 4 feet, although average height was about 6 inches.

The TIM-BOR^R powder completely dissolved in water. Slightly more than 1 gallon of solution was used to treat 40 stumps to the point of run-off. The fungal slurry preparation was viable at the time of treatment. The following are the average stump diameters (feet) for each treatment at McCloud.

Control	- Uninoculated	-	1.4 feet
Control ^R	- Inoculated	-	1.6 feet
TIM-BOR ^R	- Uninoculated	-	1.3 feet
TIM-BOR ^R	- Inoculated	-	1.5 feet

Stump disk sampling took place on June 28 and 29 and July 2. Because of skidding activities and clearing of a landing, the identity of some of the stumps was lost.

Trees on the Devils Garden Ranger District were cut on July 9. Stump height was 1 inch to 2 feet, although average height was 3-4 inches. All treatments were done within 4 hours of cutting. The TIM-BOR^R solution was prepared as before. About 1/2-half gallon of TIM-BOR^R was used to treat 40 stumps. The same HA isolates were used and prepared in the same manner. The inoculum was

viable at the time of treatment. The following were the average stump diameters (feet) for each treatment at Devils Garden.

Control	- Uninoculated	- 0.6 feet
Control ^R	- Inoculated	- 0.6 feet
TIM-BOR ^R	- Uninoculated	- 0.6 feet
TIM-BOR ^R	- Inoculated	- 0.5 feet

On July 9 the weather was sunny and warm, with air temperatures in the mid-80's F. Humidity was low. The same weather conditions continued into July 10. Sampling of stump disks was done on August 27 and 28. The disks were collected, incubated, and examined as before.

The following table presents the results from the four treatments for the two areas.

PERCENT OF PINE STUMPS INFECTED BY HETEROBASIDION ANNOSUM FOLLOWING STUMP TREATMENT

		Control	TIM-BOR ^R
McCloud	Uninoculated	15	0
	Inoculated	13	0
Devils Garden	Uninoculated	30	10
	Inoculated	95	60

Data from the two locations were combined for analysis because of the similarity of the results as far as reduction in infection. A chi-square test of independence was used to determine if the treatment had a significant effect on the level of infection. The use of TIM-BOR^R significantly reduced the amount of infection by H. annosum in both the uninoculated and inoculated trials at the 5% level.

DISCUSSION

Borax has been shown to be effective in preventing pine stump infection by H. annosum (Graham, 1970). This study shows that TIM-BOR^R, a water-soluble borate salt, is also effective in preventing infection of stumps produced by mechanical shearing. This agrees with other tests of this and similar compounds (Blakeslee, personal communication).

The inoculated trials on Devils Garden suggest that this compound may not be highly effective. The high levels of infection in this trial were likely a result of inadequate adjustment of the inoculum level and the application of an excessive inoculum load. Even though the percent of stumps infected was high in both the control and treatment groups, the number of colonies of the fungus on each stump disk that had been treated with TIM-BOR^R was much lower than the

controls. In fact, on many of the control stumps there was a "bloom" of S. meineckullus on the surface after incubation, whereas on the treatment stumps considerable time was spent examining each stump disk before a colony was discovered. The inoculum load was probably much higher than anything expected in the natural situation.

During these trials, stumps that had been operationally treated with granular borax were inoculated and examined for infection. Because of problems with the inoculum, the data were not statistically analyzed. In the McCloud trial only 7% of these stumps were infected. This is half the level of the control. At Devils Garden, 95% were infected. This is the same level as the control, but the number of colonies on the treated stumps was much lower than on the controls. This data suggests, though, that TIM-BOR^R is at least as effective as granular borax. On sheared stumps, TIM-BOR^R is probably more effective because it can adhere to and be absorbed into the vertical faces and cracks that are produced by the hydraulic shearing action. Granular borax appears to be principally effective on horizontal surfaces.

LITERATURE

Graham, D.A. 1971. Evaluation of borax for prevention of annosus root rot in California. Plant Dis. Repr. 55:490-493.